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STRACT

Reported are some of the outcomes of the second year a large computer assisted instruction program for drill and ictice in elementary school arithmetic. Conclusions drawn from an imination of the amount of computer assisted instruction completed the students and the effect of the drill and practice program cn e students were that: (1) pupils were exposed to about one-third e number of lessons originally intended, (2) software did not propriately compensate for individual differences, (3) achievement st results showed no consistent pattern favoring CAI or non-CAI oups, (4) the amount of drill and practice in CAI and non-CAI asses were not observably different, and (5) attitudes toward the ogram of students, teachers, administrators, and parents were vorable. (Author/FL)

Evaluation of the New York City Computer Assisted Instruction Project in Elementary Arithmetic, Second Year, 1969-70

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ABSTRACT

This report describes some outcomes of the second year of a large scale Computer Assisted Instruction (CAI) program for drill and practice in elementary arithmetic, grades 2 through 6, in New York City.

The study concluded that: 1) pupils were exposed to approximately one-third the number of CAI lessons originally intended, 2) software did not appear to appropriately compensate for individual differences in ability, 3) achievement test results showed no consistent pattern favoring CAI or non-CAI groups, 4) apart from work at the CAI terminals, the amount of drill and practice in CAI and non-CAI classes were not observably different, and 5) attitudes toward the program of pupils, teachers, administrators, and parents were favorable.

The recommendations were: 1) number of pupils on CAI should be controlled so that the system is not overloaded, 2) amounts of time and number of exposures to the program should be varied for pupils at the extremes of the ability continuum, 3) coordination between classroom instruction and the CAI program should be improved, 4) the program should be modified so that data are readily retrievable for research and evaluation as well as management of CAI operations.

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In September 1968 the New York City Board of Education initiated a project for a large-scale test-demonstration of a computer assisted instruction program for drill and practice in elementary arithmetic. This program was a modified version of an earlier arithmetic drill and practice program based on work done by Dr. Patrick Suppes of Stanford University and others. The present report will describe some outcomes of the program in the second year.

From the outset it must be emphasized that the present study is not an experiment in the classical sense. It may best be characterized as a descriptive study of particular groups of pupils at schools where there were CAI terminals compared with similar groups in schools where there were no CAI terminals. In the spring of 1969 the evaluation team proposed studies to carry out a number of experiments which would help to provide more definitive answers to such questions as (1) to what extent is the learning attributable to CAI and not other variables, and (2) how do alternative instructional techniques compare with CAI? The proposed studies were disapproved by the ESEA, Title III staff and their consultant as not feasible.

The writers were aware of the methodological and statistical problems involved but also recognized that, as in any large-scale project, data must be collected and analyzed as appropriately as possible despite the

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lack of the desired degree of experimental control. In order to satisfy as many as possible of the viewpoints concerning appropriate data analysis it was decided to analyze the achievement test data at each grade level by using 1) analysis of covariance on total groups, 2) analysis of variance of gains on total groups, and 3) analysis of variance of post-test scores on matched subgroups.

Specifically stated, this evaluation examined the amount of CAI work completed by the pupils and the effect of the CAI drill and practice program on:

1. arithmetic achievement at each grade level, from grades 2 through grade 6.
2. arithmetic achievement of high and low achievers at each grade level, from grades 2 through 6.
3. arithmetic achievement of high and low achievers in grades 3 and 5 if the time factor is removed.
4. the error rates and latencies of high and low achievers in grade 4.
5. reading achievement of high and low achievers in arithmetic in grades 3 through 6.
6. pupil opinions and attitudes toward CAI, toward arithmetic, and toward learning in general.
7. teaching procedures in elementary arithmetic.
8. the opinions and attitudes of teachers, school administrators, and parents.

In addition, information was sought on a number of subsidiary questions, namely:

1. How is the effect of the CAI treatment influenced by the pupils' sex and race?
2. Did CAI affect learning of arithmetic concepts as measured by tests less familiar to pupils than the MAT?
3. Did the 10-second time limit on CAI exercises interfere with learning for the pupils at the lowest achievement level?

Conclusions

On the basis of the information obtained during the study of the 1969-70 New York City CAI project, the evaluation team has concluded that: (Tables are appended to the end of this paper.)

1. At all grade levels the average number of concept blocks completed by pupils was much smaller than expected. On the average, approximately 55 CAI lessons were completed by a sample of 138 fourth grade pupils. The original expectation intended by the designers of the program was that the pupils would complete between 140-168 CAI lessons.
2. With the exception of the fifth grade, there was a greater amount of CAI work completed by high than by low ability pupils despite the fact that the five difficulty levels in the program were to have made it possible for all pupils to proceed through the material at a comparable rate. The provision in the CAI program for matching differences in pupil ability to different difficulty levels was insufficient to lead to comparable achievement between high and low ability pupils as measured by the number of items completed, percent correct, number of time outs and item latencies. (See Table 1.)

3. Although in general, the CAI experience as implemented in New York City during 1969-70 did not lead to losses, it did not lead to gains in measured achievement in arithmetic computation beyond those gains achieved by comparison groups. (See Table 2.) These results contrast sharply with the results obtained in the 1968-69 CAI evaluation. Among the possible reasons for the difference between these results and those obtained in the 1968-69 CAI evaluation, two seem to be quite plausible. First, the effect of the CAI innovation may cause an initial increase in pupil achievement when it is first instituted but this level of performance may not be subsequently maintained when the program becomes a more accepted phase of the day to day school activity. Secondly, more CAI drill and practice exercises may have been completed by the pupils whose achievement was measured during the first year of the program.

4. When the comparisons between CAI and non-CAI groups were examined for pupils at different grade levels, different abilities, different sexes, and different ethnic backgrounds somewhat conflicting results were obtained. At grade five the significant differences favored the CAI pupils while at grade six the differences favored the non-CAI pupils. Other than these, the differences obtained were few and scattered and showed no consistent pattern.

5. In general, exposure to the CAI arithmetic program could not be said to have affected reading ability.

6. The results of an untimed test based on the work presented to the pupils at the CAI terminals tended to indicate that the program was not ideally adjusted for low ability level pupils. This finding corresponds to that given in statement 2. above, and lends further credence to last year's tentative finding based on the analysis of limited data related to this question.
7. Although the CAI teachers reported spending more time on preparation than the non-CAI teachers, observers generally found little difference between CAI and non-CAI teachers in the length of their arithmetic lessons or the amount of time they devoted to drill and practice.
8. Observers reported that arithmetic lessons were generally not well coordinated with work at the terminals but that there was a greater degree of coordination this year than last year.
9. A large percentage of all categories of respondents to interviews or questionnaires had a favorable attitude toward CAI and indicated that they would like to continue the program. They also felt that work at the terminals helped the children learn arithmetic better and the teachers indicated that this was especially true of the pupils in the middle ability range.
10. Although the CAI and non-CAI pupils did not respond differently about the amount of communication dealing with schoolwork that they had with their parents, the CAI parents felt that their children spoke to them more often about school in general and arithmetic in particular than did the non-CAI parents.

Recommendations

Based on the above findings the evaluation team makes the following recommendations:

1. The Central CAI office should have more autonomy and should be considered a line rather than a staff position so that crucial decisions related to implementation of the CAI system can be uniformly carried out. This would lead to greater control over the number of pupils assigned to CAI so that the capability of the system to adequately deliver instruction to the pupils is not overloaded. It would also enable closer monitoring of the day by day operation and provide for the necessary flexibility in dealing with specific situations in specific schools.
2. A concerted effort should be made to correlate the instruction given by the teacher and the drill and practice given at the CAI terminals. This would require very careful scrutiny of both the New York City arithmetic curriculum and the CAI drill and practice program so that at the beginning of the school year appropriate time and sequence schedules could be drawn up and followed. Such scheduling may not be feasible for all the classes in all the schools but should be carefully done in some classes in some of the schools. This type of scheduling is extremely important if the CAI system is to be fairly tested.
3. Those teachers who have had experience with CAI and have shown that they are adept at coordinating their teaching with CAI should work as a group to identify their own method of relating their classroom practices to CAI. They should then develop a

guide specifically for New York City teachers, taking into account the curriculum and pupil characteristics, and should subsequently serve as demonstration teachers.

4. Pupils at the extremes of the ability continuum should be allowed to have different amounts of time and/or number of exposures to the system. Schedules might be arranged so that the most able pupils might have 20-25 minutes of CAI a week, whereas those at the other extreme might be given as long as 80-100 minutes.

5. Questions pertaining to behaviors and attitudes of those involved in the CAI program (pupils, teachers, parents) should continue to be examined by the school administrators in New York City as part of an ongoing appraisal of the effect of CAI as it operates in the school system as a whole and in specific schools.

6. The record keeping function of the CAI software should be modified so that the data is stored in such a way as to be readily retrievable for answering questions about management of CAI operations as well as research and evaluation questions.

7. If future evaluations are to be conducted evaluators should be permitted to set up more rigorous designs so that (1) more control can be exercised over the selection of the participants in the CAI study and (2) so that less expensive alternative instructional techniques such as programmed instruction, tutoring, workbooks, etc., can be evaluated simultaneously with CAI.

8. Although CAI requires an expensive installation and its use involves some difficult adjustments, the data accumulated thus far do not rule out the strong claims initially made for CAI as a potentially powerful aid to instruction. In view of the initially favorable comparative test results and in view of the strong positive motivations that CAI appears to engender, experimentation should certainly continue, and effort should be concentrated on overcoming weaknesses in the content and conditions of use of this particular CAI operation.

Table 1

Mean Number of Items, Error Rates, and Latencies during the Months of October and November, 1969 for a Random Sample of 101 Fourth Grade Pupils Grouped According to MAT Pre-Test Score

	Total No. of Items Completed	Percent Correct	Percent Incorrect	Percent Time-Outs	Latency Correct Ans. (seconds)	Latency Incorrect Ans. (seconds)
MAT High N = 32	162.50	.85	.10	.04	3.88	5.26
MAT Average N = 41	134.29	.79	.15	.06	4.03	5.34
MAT Low N = 28	124.68	.71	.22	.07	4.15	4.71

Table 2

Summary of the Analyses of the MAT Test Data Comparing CAI and Non-CAI Pupils

Grade		ANOVA (Gains)	ANCOVA (Pre-test as Covariate)	ANOVA (Matched-group design)	ANOVA (Matched-pairs design)	
2	All	-	5	-	5	1=P < .01
	Females	-	-	-	5	5=P < .05
	Males	-	-	-	-	-- Not significant
3	All	-	-	-	-	
	Females	-	-	-	5	
	Males	-	-	-	-	
4	All	-	-	-	-	
	Females	-	-	-	-	
	Males	-	-	-	-	
5	All	1	1	-	5	
	Females	-	-	-	-	
	Males	5	1	-	1	
6	All	-	1n[1]	-	5n	
	Females	-	5n	-	5n	
	Males	-	-	-	-	

[1] n indicates the comparison favored the non-CAI group.